(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
29 July 2004 (29.07.2004)

PCT

(10) International Publication Number
WO 2004/063535 A1

(51) International Patent Classification[7]: F01D 25/18

(21) International Application Number:
PCT/IB2003/000042

(22) International Filing Date: 10 January 2003 (10.01.2003)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant *(for all designated States except US)*: **HONEYWELL INTERNATIONAL INC.** [US/US]; 101 Columbia Road, Morristown, NJ 07962 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **MATHIEU, Philippe** [FR/FR]; Honeywell Garrett, B.P. 19 - Z.I. Route d'Oncourt, F-88150 Thaon-les-Vosges (FR). **FIGURA, Giorgio** [FR/FR]; Honeywell Garrett, B.P. 19 - Z.I. Route d'Oncourt, F-88150 Thaon-les-Vosges (FR). **GENIN, Emeric** [FR/FR]; Honeywell Garrett, B.P. 19 - Z.I. Route d'Oncourt, F-88150 Thaon-les-Vosges (FR). **LAVEZ, Alexis** [FR/FR]; Honeywell Garrett, B.P. 19 - Z.I. Route d'Oncourt, F-88150 Thaon-les-Vosges (FR).

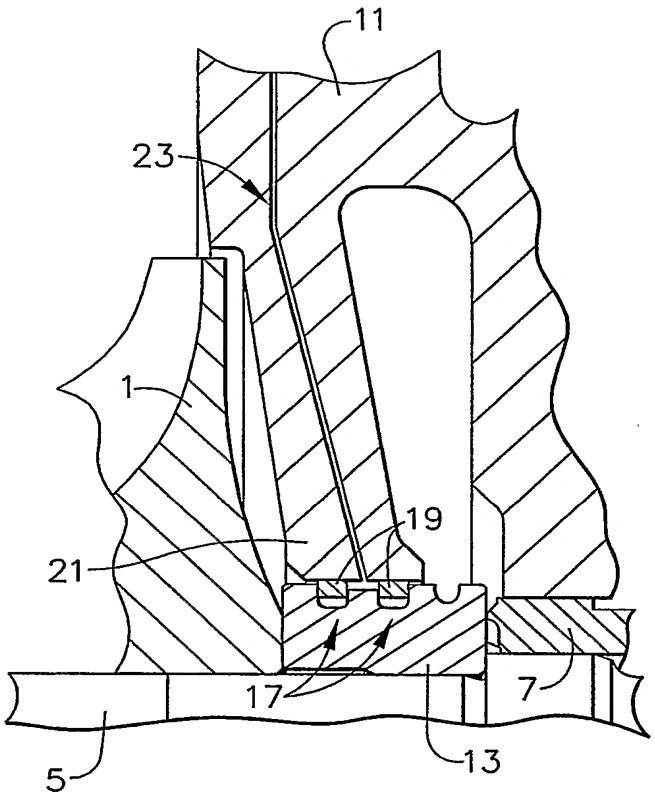
(74) Agents: **LESON, Thomas, Johannes, Alois** et al.; TBK-Patent, Bavariaring 4-6, 80336 München (DE).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: SEALING MEANS FOR A LUBRICATION SYSTEM IN A TURBOCHARGER



(57) Abstract: A turbocharger comprises a compressor impeller (1) connected by a shaft (5) being rotatably supported in a bearing with a turbine wheel (3) and at least one sealing arrangement with a sealing portion for avoiding leakage from the bearing to the space where one of the compressor impeller and the turbine wheel are located. The sealing arrangement comprises at least one passage (23) for increasing the pressure at a low pressure side of the sealing portion consisting of a seal ring. The turbocharger can be preferably used in a multi-turbocharger boosting system.

WO 2004/063535 A1

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

SEALING MEANS FOR A LUBRICATION SYSTEM IN A TURBOCHARGER

The invention relates to a turbocharger, preferably to a turbocharger for an internal combustion engine. The invention further relates to a multi-turbocharger boosting system.

According to document US 4,157,834 there is known a turbocharger with one or more conventional sealing portions each comprising a circumferential groove accommodating a sealing ring. Further sealing arrangements are disclosed in the documents EP-A1-1245793, EP-A2-1130220 and WO-A2-02086293.

The object of the invention is to provide an improved turbocharger and an improved multi-turbocharger boosting system.

According to an aspect of the invention the object is achieved by the combination of the features defined in each of the independent claims. Preferable embodiments of the invention are set forth in the subclaims.

According to an embodiment the turbocharger according to the invention comprises a compressor impeller connected by a shaft being rotatably supported in a bearing with a turbine wheel and at least one sealing arrangement with a sealing portion for avoiding leakage from the bearing to the space where one of the compressor impeller and the turbine wheel are located. The sealing arrangement comprises at least one pressure increasing means for increasing the pressure at a low pressure side of the sealing portion.

In a preferred embodiment the low pressure side of the sealing portion is the side being communicated with and/or facing the space where one of the compressor impeller and the turbine wheel are located.

Further, it is preferable to use a passage as pressure increasing means, which passage is communicated with air outside of the turbocharger or with the space where the turbine wheel is located.

It is further preferable to design the sealing portion as a circumferential groove accommodating a sealing ring and in particular to provide the groove in the shaft with the ring being abutted under pressure against one of the side walls of the groove and a radially opposite surface of an opening where the shaft is accommodated. To accomplish such an arrangement it is further preferable that both the sealing ring and the groove have a rectangular cross section, wherein the size and cross-section of the sealing ring are such that in the sealing position of the ring a radial and axial clearance between the high pressure side of the ring and the groove can be established.

According to a further embodiment the sealing arrangement comprises one or more additional sealing portions, wherein the pressure increasing means is provided between two adjacent sealing portions.

Alternatively the sealing arrangement comprises one or more additional sealing portions, wherein said pressure increasing means are communicated with the space where one of the compressor impeller and the turbine wheel are located, preferably adjacent to the sealing portion behind the compressor impeller or the turbine wheel, respectively. Here it is particularly preferable that the passage of the pressure increasing means merges into the opening in which the shaft is rotatably accommodated.

According to another aspect of the invention there is provided a multi-turbocharger boosting system comprising at least a first turbocharger and a second turbocharger, wherein at least

the second turbocharger is a turbocharger according to one of the embodiments mentioned above. In a preferred embodiment of the multi-turbocharger boosting system the pressure increasing means of the second turbocharger are communicated with the compressor output and/or the turbine input of the first turbocharger.

According to a still further aspect of the invention there is provided a turbocharger with a turbine side actuating mechanism for actuating a device within the turbocharger housing from outside the turbocharger housing, said mechanism comprising a rod which is rotatably mounted in the turbocharger housing for transmitting an actuating movement from outside the turbocharger housing to the device, wherein the rod is provided with a sealing portion for avoiding gas leakage. In a preferred embodiment the device is a variable nozzle device comprising an unison ring for actuating vanes forming nozzle passages and the actuating mechanism is a linkage mechanism comprising the rod being coupled at one end to a link arm coupled to the unison ring and the other end coupled to external adjusting means, wherein the sealing portion is formed as explained above with regard to the first aspect of the invention.

In the following the invention with its function, effects and advantages will be explained by embodiments as examples with reference to the enclosed drawings in which

Figure 1 shows a cross-sectional view of a first embodiment of the turbocharger according to the invention;

Figures 2 and 3 show enlarged views of the seal portion of the turbocharger in Fig. 1 at the compressor and turbine side thereof, respectively;

Figure 4 illustrates a layout of a multi-turbocharger boosting system in which a turbocharger according to the invention is incorporated;

Figure 5 shows a cross-sectional view of a second embodiment of the turbocharger according to the invention;

Figures 6 and 7 show enlarged views of the seal portion of the turbocharger in Fig. 5 at the compressor and turbine side thereof, respectively;

Figure 8 shows a cross-sectional view of a third embodiment of the turbocharger according to the invention;

Figure 9 shows an enlarged cross-sectional view of the third embodiment of the turbocharger where a cartridge accommodating a variable nozzle device is used;

Figure 10 shows an enlarged cross-sectional view of a fourth embodiment of the turbocharger according to the invention;

Figure 11 shows an enlarged cross-sectional view of an actuation mechanism according to the invention; and

Figure 12 shows an enlarged cross-sectional view of the sealing portion of the actuation mechanism in Fig. 11.

The essential parts of a turbocharger according to a first embodiment of the invention are illustrated in Fig. 1 where details of the turbocharger housing and the particular construction of the turbocharger parts are not shown in detail. The turbocharger comprises a compressor impeller 1 and a turbine wheel 3 mounted on the opposite ends of a common shaft 5. The shaft 5 is freely rotatable in a bearing 7 provided with an oil supplying system 9 the arrangement of which is not particularly shown in Fig. 1. The bearing 7 is supported in a center housing 11. On both ends of the shaft 5, just behind the impeller 1 and the turbine wheel 3, there are provided two seal portions 13 and 15, respectively, for

avoiding that oil from the bearing 7 leaks out from the space encompassed by the center housing 11. In this embodiment the seal portion 15 at the turbine wheel side is formed as an enlarged portion of the shaft 5, whereas the seal portion and the impeller side of the shaft is formed as a seal sleeve or oil slinger 13.

As particularly shown in Fig. 2 in the outer circumferential surface of the oil slinger 13 there are provided two circumferential grooves 17 in which seal rings 19 are accommodated for providing a leak-tight seal between the oil slinger 13 and a collar portion 21 of the center housing 11. In the collar portion 21 there is provided at least one ventilation passage 23 which merges between the seal rings 19 into a central shaft opening formed by the collar portion 21 in order to communicate this opening with the air outside the turbocharger.

As further shown in Fig. 3 the extended diameter portion of the shaft 5 is also provided with a twin-groove arrangement similar to the described above, where in grooves 25 there are accommodated seal rings 27. A turbine side collar portion 29 of the center housing 11 forms a central opening encompassing the large diameter seal portion 15 of the shaft 5 and is in abutment with the seal or piston rings 27. The portion of the central shaft opening extending between the seal rings 27 is communicated with the air outside the turbocharger by means of a ventilation passage 31 which extends within the turbine side collar portion 29.

Both the above described oil seal system at the impeller side shown in Fig. 2 and the oil seal system at the turbine side shown in Fig. 3, prevent the oil supplied to the bearing 7 from leaking to the space where the impeller is arranged and thus contaminating the intake air of the combustion engine. Such situation occurs at low compressor speeds and mostly during operation modes in which there is almost no rotation

of the compressor. Therefore, it is particularly advantageous to use a turbocharger having the above-described oil sealing system in a multi-turbocharger boosting system shown in Fig. 4.

The system comprises a first turbocharger 601 and a second turbocharger 602, wherein the two turbochargers are connected generally parallel in relation to an internal combustion engine 603. The first turbocharger 601 comprises preferably a free floating turbine 605 at its turbine side, whereas the second turbocharger 602 is equipped with a variable geometry turbine 607. The turbines 605 and 607 and respective compressors 609 and 611 are connected in parallel. According to the layout fresh air is fed in parallel to each of the compressors by means of a first fresh air conduit 604 and second fresh air conduit 606 and the air discharged from the compressors is guided through an intercooler 612 to the intake side of the internal combustion engine 603. At the turbine side of the layout the exhaust from the engine 603 is fed through a first exhaust conduit 608 and a second exhaust conduit 610 branching from a conduit or piping 623 to the first and second turbine 605 and 607, respectively, and the exhaust discharged from the parallel turbines is guided to a catalyst 614.

In the multi-turbocharger boosting system shown in Fig. 4 the second compressor 611 is provided with an air re-circulation system using air flow regulating means for adjusting the amount of the re-circulated air. The re-circulation system in this embodiment includes a by-pass conduit 613 with a butterfly valve 615 for adjusting the air mass-flow re-circulated back into the second fresh air conduit 606 connecting the inlet of the second compressor 611 with an air filter 619.

The multi-turbocharger boosting system further comprises an additional butterfly valve 639 being arranged in the conduit

641 connecting the second compressor 611 with the intercooler 612 between the merging point of the by-pass conduit 613 downstream of the second compressor 611 and the merging point of the first compressor 609 in the conduit 641.

At the turbine side of the multi-turbocharger boosting system there is provided a bypass passage 625 with a corresponding waste gate valve 629. A butterfly or throttle valve 633 is arranged in the second exhaust conduit 610.

The multi-turbocharger boosting system according to Fig. 4 allows a highly efficient function of the internal combustion engine at low, medium and high rotational speeds of the internal combustion engine.

At a low rotational speed of the internal combustion engine 103, which means at about 1000-2000 rpm, the exhaust gas supplied through the exhaust conduit or piping 623 drives the free floating turbine 605 of the first turbocharger 601. The butterfly valve 633 is closed or nearly closed to reduce exhaust gas flow into turbine 607 to ensure an idling rotation of the second turbocharger 602 so as merely to avoid oil leakage from the bearing system thereof. Under this condition the speed of the first turbocharger is controlled by means of the waste gate valve 629. At this stage the first turbocharger works normally to supercharge the engine 603.

At the low rotational speed, the butterfly valve 615 is open so that a re-circulation at the second compressor 611 is achieved. Due to the particular design of the layout, during the re-circulation the pressure in the second compressor 602 can be lowered so that the trust load becomes less important and the reliability is improved.
The additional butterfly valve 639 remains closed and the first compressor 609 works normally to supercharge the engine 603.

In the range of a medium rotational speed of the internal combustion engine, which means at about 2000-2500 rpm, the butterfly or throttle valve 633 opens progressively so as to regulate the pressure before the turbine and the exhaust gas flow drives the second turbocharger 602. In the same time the butterfly valve 615 is progressively closed in order to balance the power between the second compressor 611 and the second turbine, so that by operation of the butterfly valve 615 the speed of the second turbocharger 602 can be regulated.

In the range of a high rotational speed of the internal combustion engine, which means at about 2500 - 4000 rpm, the butterfly valve 633 is completely or almost completely open, wherein the speed of the turbine 605 is regulated by means of the waste gate valve 629. During this operation the additional butterfly valve 639 is open and the butterfly valve 615 is totally closed.

In the above-mentioned mode of operation at a low rotational speed, the butterfly valve 633 can be closed or nearly closed without causing thereby an oil leakage. Although the pressure behind the impeller 1 of turbocharger 602 becomes quite low, the pressure drop at the outer piston ring 19 is decreased by ventilating the space between the outer and inner piston rings by air at normal atmosphere pressure. The further seal ring 19 positioned between the ventilation passage 23 and the bearing 7 is also subject to reduced pressure drop so that an oil leakage to the impeller side of the turbocharger can be efficiently avoided even if the rotation of the second turbocharger is stopped.

The ventilation passage 31 arranged at the turbine side as shown in Fig. 3 has almost the same function as the ventilation passage 23 at the impeller side of the turbocharger. At low rotational speed of the internal

combustion engine, there is also a significant drop in pressure in the space around and behind the turbine wheel 3.

According to the second embodiment shown in Figs. 5, 6 and 7 the outer seal arrangement consisting of a seal or piston ring and a groove can be omitted, whereas the merging point of the ventilation passage is to be arranged close to a single piston ring at the corresponding groove. As illustrated by Fig. 6 the collar portion 121 of the center housing 111 is formed with an invertly sloped surface, wherein the merging point of the ventilation passage 123 is arranged at the radially invert almost lowest part of the sloped surface in close proximity to the seal arrangement 117, 119.

However the merging point of the ventilation passage can be also directly arranged in the center opening of the collar portion 121, so that the clearance of the fit between the shaft and the center opening in the portion between the merging point and the compressor space serves as throttling means.

As shown in Fig. 7 almost the same design as the design shown in Fig. 6 is adopted for the turbine side of the turbocharger where a ventilation passage 131 communicates the space behind the turbine wheel being closest to the seal arrangement 125, 127 with the air outside the turbocharger.

With regard to the second embodiment shown in Figs. 5 to 7, in this embodiment the same design of the oil slinger 113 and the enlarged seal portion 115 of the shaft 105 as in the first embodiment is used. This means that although these elements keep the above-described twin-groove design only the respective collar portions 121 and 129 are designed such that the central openings thereof face only one seal arrangement consisting of one groove and one seal ring.

According to a third embodiment of the invention shown in Figs. 8, 9 and 10 a variable geometry nozzle device is designed and arranged in such a way between the center housing 111 and a turbine housing 235 that there is provided at least one gas passage 237 which communicates the exhaust gas inlet side of the turbine with the ventilation passage 231 as shown in Figs. 9 and 10 representing arrangements of the ventilation passage at the turbine side similar to the second and first embodiment, respectively.

According to a further embodiment of the invention shown in Fig. 11 and 12 there is provided a particular construction of an actuation device 241 comprising a lever for circumferentially shifting the unison ring 245 of the variable nozzle device shown in Fig. 9. In this embodiment an actuating shaft 247 of the actuation device is rotatably supported in a bushing 249 interposed in the center housing 211. Between the actuating shaft or crank pin 247 and the bushing 249 there is provided a seal arrangement consisting of a circumferential groove 251 and a seal ring 253. The seal ring 253 has elastic properties which allows each to be stocked into the bushing internal face as is the case with the seal rings described above. As can be understood from the illustration in Fig. 12 the seal ring has a substantially rectangular cross-section with two adjacent sealing surfaces abutting against the bushing 249 and the crank pin 247. For this purpose the axial thickness of the seal ring 253 is smaller than the axial width of the groove 251, whereas the inner diameter of the seal ring 253 exceeds the diameter of the bottom portion of the groove 251, such that an L-shaped clearance 255 shown in Fig. 12 is established when the seal ring is exposed to the exhaust gas pressure from the right side in Fig. 12.

The above construction of the actuation device 241 can be applied in each of the third and fourth embodiment shown in Figs. 9 and 10.

Furthermore the sealing portion described above with reference to Figures 11 and 12 is also preferably applicable in each of the embodiments described above with reference to Figures 1 to 10.

CLAIMS

1. A turbocharger comprising a compressor impeller connected by a shaft being rotatably supported in a bearing with a turbine wheel and at least one sealing arrangement with a sealing portion for avoiding leakage between the bearing and the space where one of the compressor impeller and the turbine wheel are located, wherein said sealing arrangement comprises at least one pressure increasing means for increasing the pressure at a low pressure side of the sealing portion.

2. A turbocharger according to claim 1, wherein said low pressure side of the sealing portion is the side being communicated with and/or facing said space where one of the compressor impeller and the turbine wheel are located.

3. A turbocharger according to claim 2, wherein said pressure increasing means comprises a passage communicated with air outside of said turbocharger.

4. A turbocharger according to claim 2, wherein said pressure increasing means comprises a passage communicated with the space where the turbine wheel is located.

5. A turbocharger according to one of claims 2 to 4, wherein the sealing portion comprises a circumferential groove accommodating a sealing ring.

6. A turbocharger according to claim 5, wherein said sealing ring and said groove have a rectangular cross section and wherein the size and cross-section of the sealing ring are such that in the sealing position of the ring a radial and axial clearance between the high pressure side of the ring and the groove can be established.

7. A turbocharger according to one of claims 2 to 6, wherein the sealing arrangement comprises one or more additional sealing portions wherein said pressure increasing means is provided between two adjacent sealing portions.

8. A turbocharger according to one of claims 2 to 6, wherein the sealing arrangement comprises one or more additional sealing portions wherein said pressure increasing means are communicated with the space where one of the compressor impeller and the turbine wheel are located, preferably adjacent to the sealing portion behind the compressor impeller or the turbine wheel, respectively.

9. A multi-turbocharger boosting system comprising at least a first turbocharger (601) and a second turbocharger (602), wherein at least the second turbocharger (602) is a turbocharger according to one of claims 1 to 8.

10. A multi-turbocharger boosting system according to claim 9, wherein the pressure increasing means of the second turbocharger (602) are communicated with the compressor output and/or the turbine input of the first turbocharger (601).

11. A turbocharger with a turbine side actuating mechanism for actuating a device within the turbocharger housing from outside the turbocharger housing, said mechanism comprising a rod which is rotatably mounted in the turbocharger housing for transmitting an actuating movement from outside the turbocharger housing to the device, wherein said rod is provided with a sealing portion for avoiding gas leakage.

12. A turbocharger according to claim 11, wherein said device is a variable nozzle device comprising an unison ring for actuating vanes forming nozzle passages and the actuating mechanism is a linkage mechanism comprising said rod being coupled at one end to a link arm coupled to the unison ring and

the other end coupled to external adjusting means, and wherein said sealing portion is a sealing portion according to claim 5 or 6.

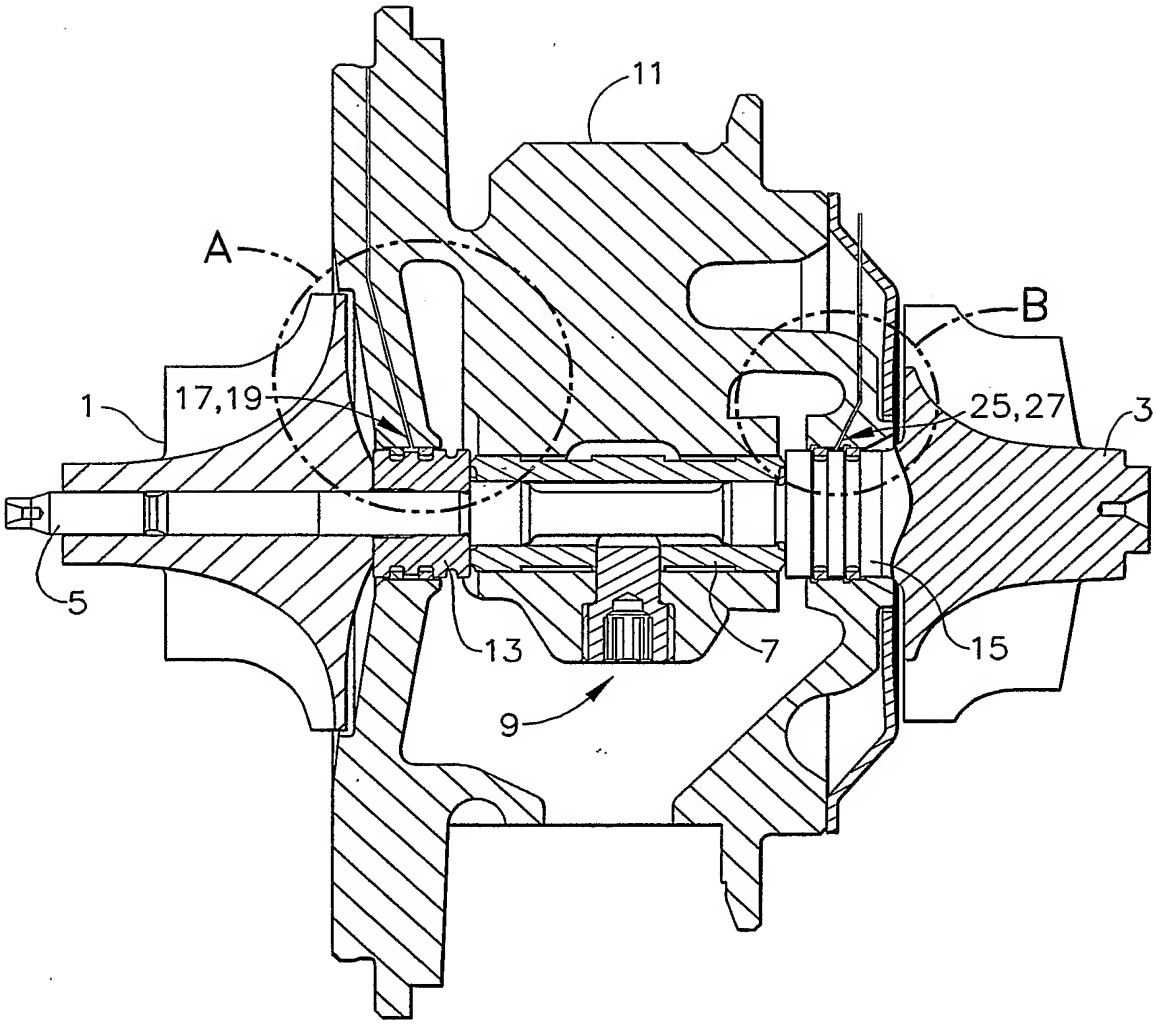


FIG. 1

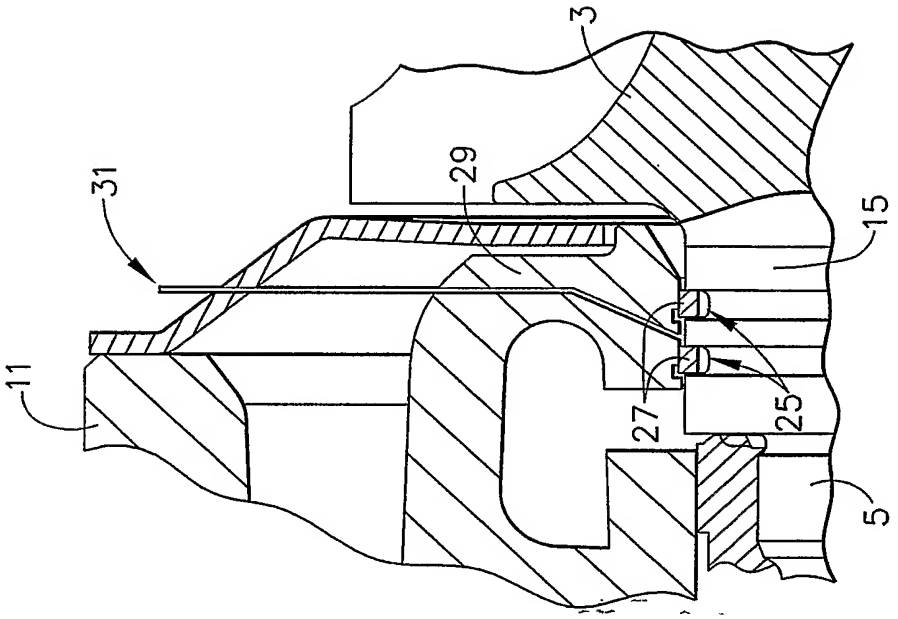


FIG. 3

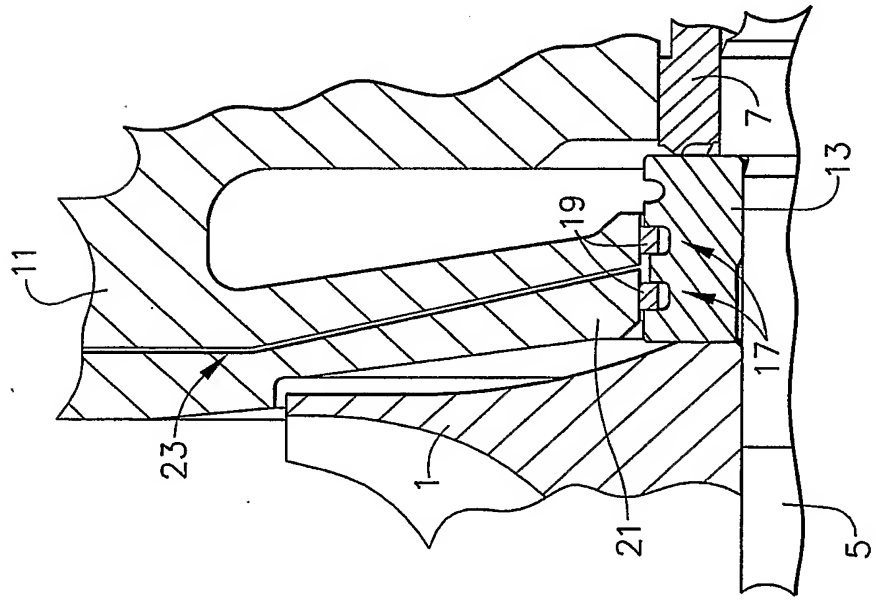


FIG. 2

3/8

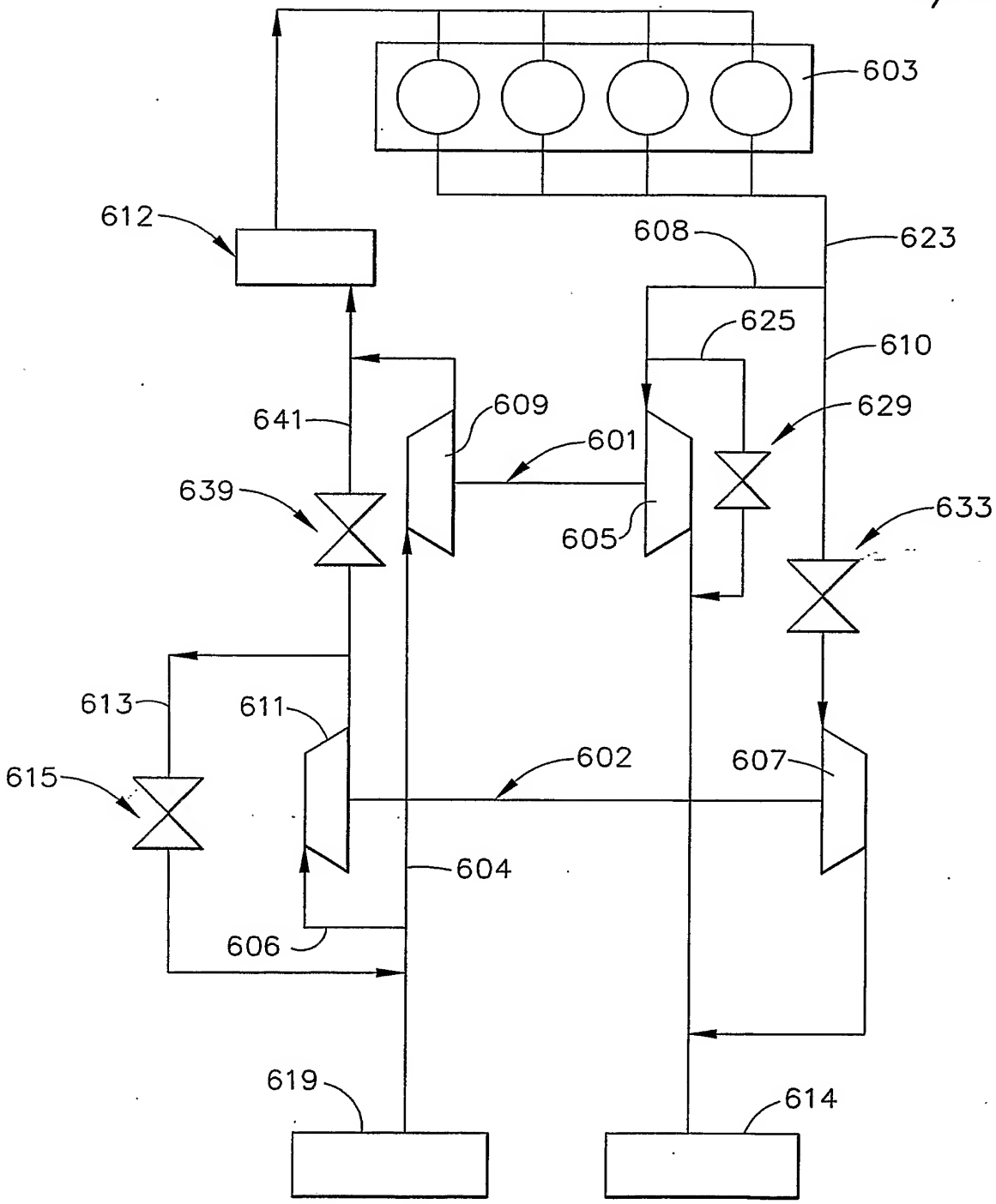

603
612
608
623
625
610
641
609
601
629
639
605
633
613
611
602
607
615
604
606
619
614

FIG. 4

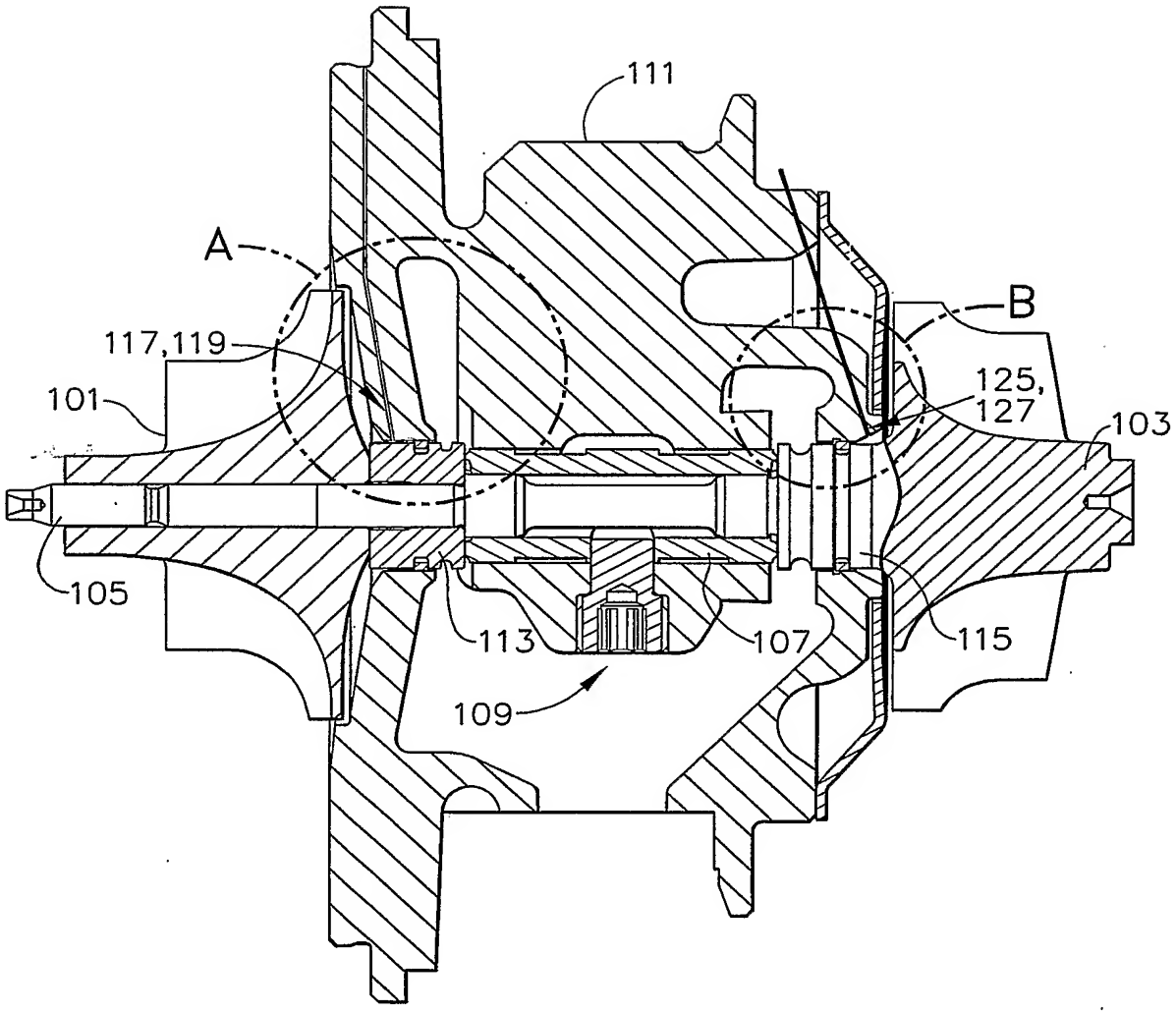


FIG. 5

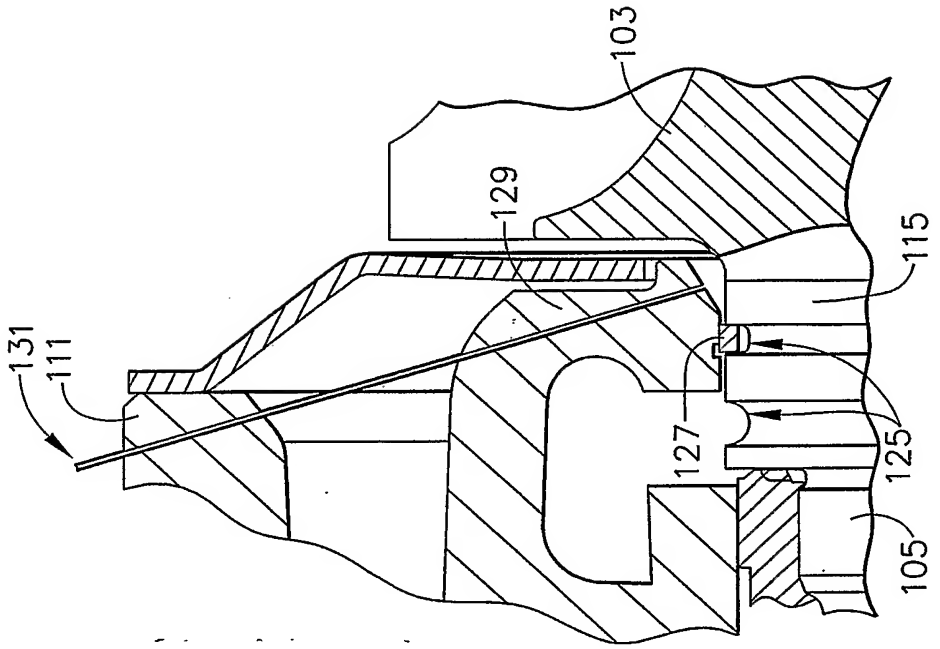

103
129
115
131
111
127
125
105

FIG. 7

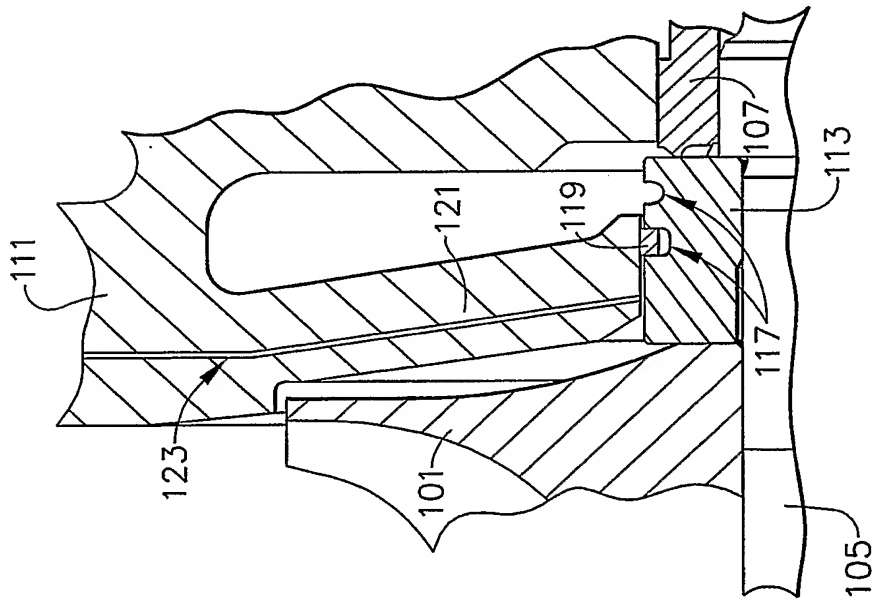

107
113
121
119
111
117
123
101
105

FIG. 6

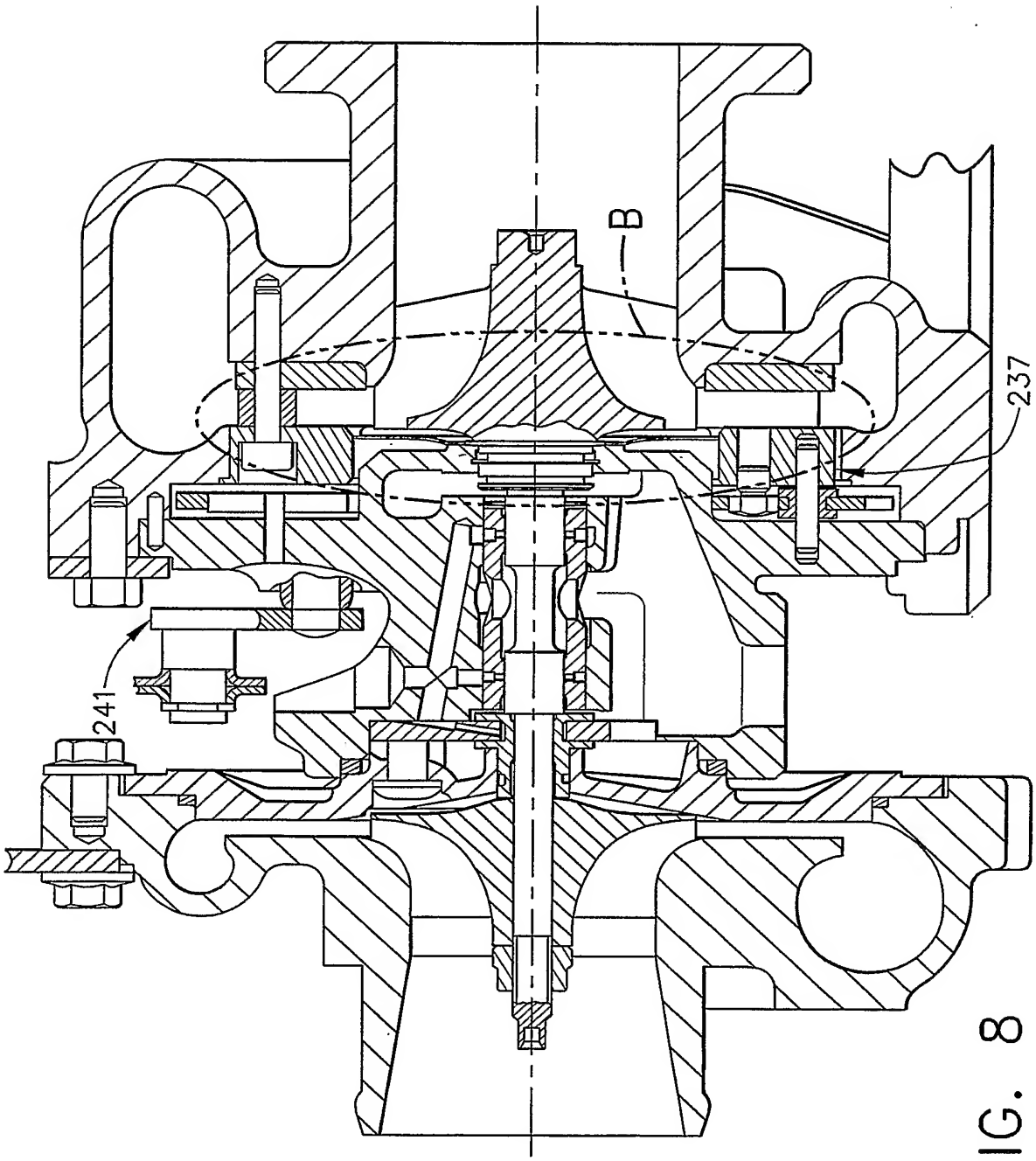


FIG. 8

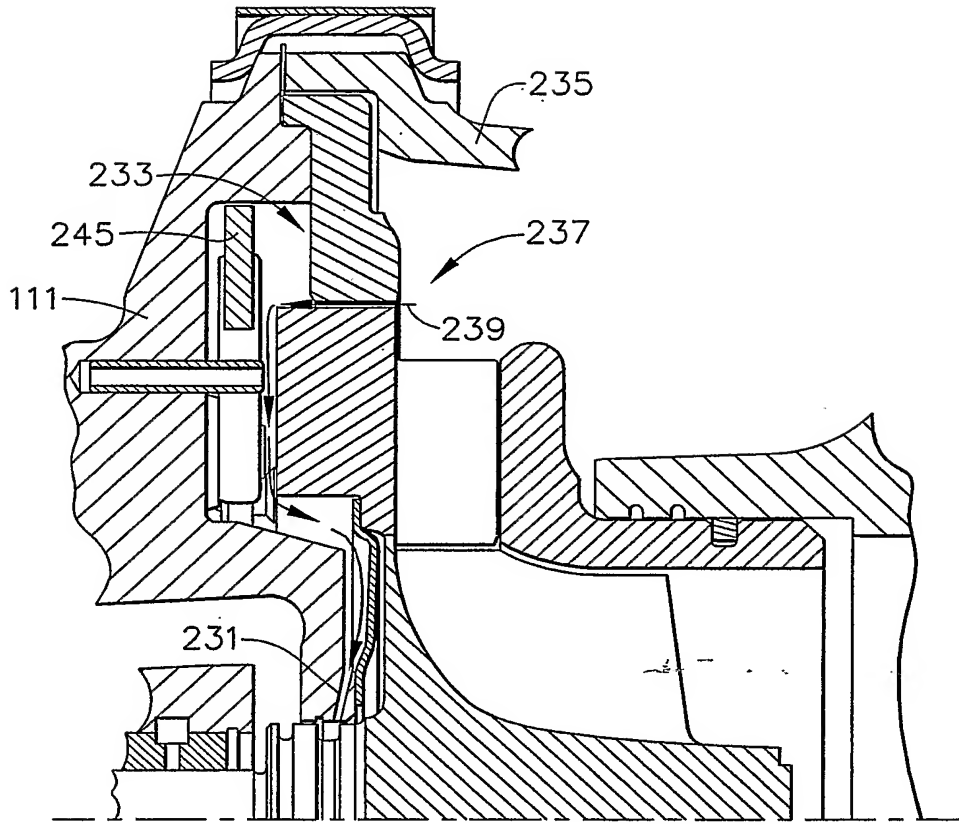


FIG. 9

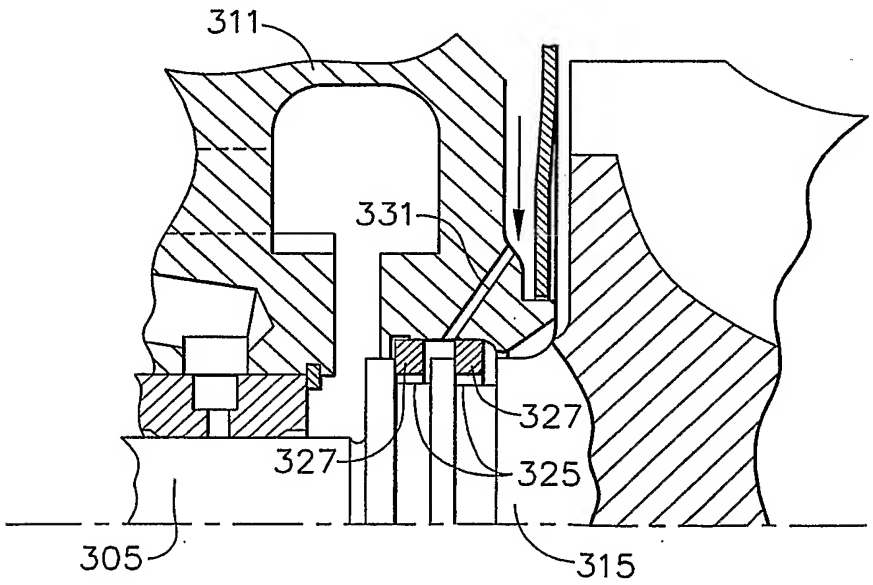


FIG. 10

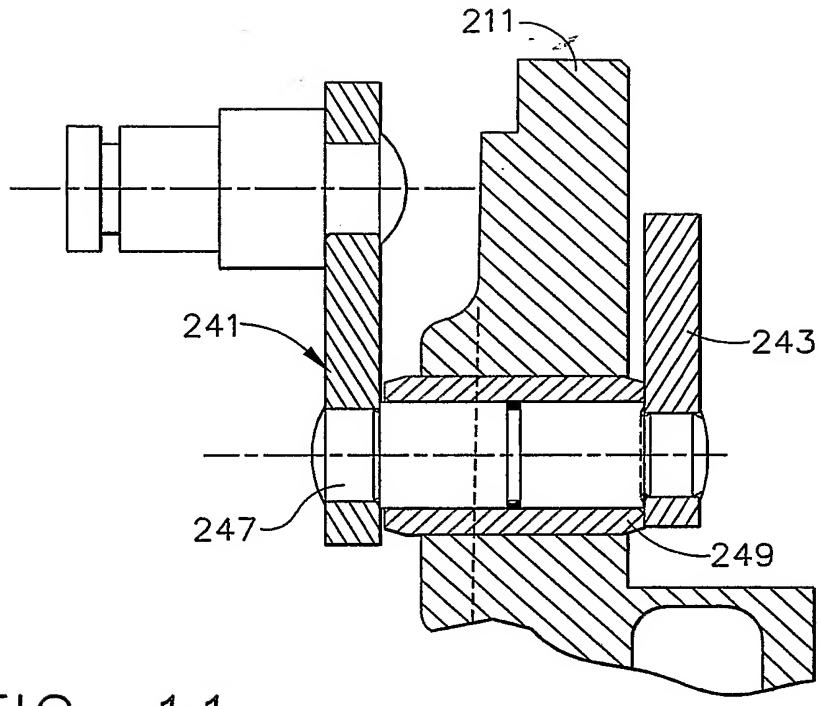


FIG. 11

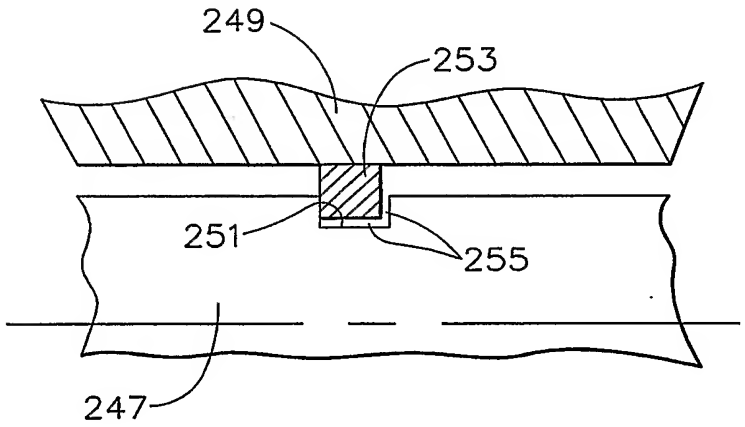


FIG. 12

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB 03/00042

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F01D25/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	EP 0 357 246 A (NISSAN MOTOR) 7 March 1990 (1990-03-07) abstract; figures 3-6 page 2, line 1 - page 2, line 20 page 4, line 32 - page 5, line 19	1-3,5-7 9,10
X	US 3 825 311 A (MURRAY B) 23 July 1974 (1974-07-23) abstract; figures column 1, line 63 - column 1, line 67 column 2, line 20 - column 3, line 9	1,2,4,7, 8
X	DE 38 17 617 A (DAIMLER BENZ AG) 20 July 1989 (1989-07-20) the whole document	1-3,5,7

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 September 2003	01. 12. 2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	De Rooij, M.

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB 03/00042

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 273 765 A (GEN MOTORS CORP) 8 January 2003 (2003-01-08) abstract; claims; figures paragraph [0001] paragraph [0003] - paragraph [0006] paragraph [0017] - paragraph [0018] -----	1-3,8
Y	US 4 752 193 A (HOERLER HANSULRICH) 21 June 1988 (1988-06-21) abstract; claims; figures column 1, line 11 - column 2, line 2 column 2, line 45 - column 2, line 53 column 3, line 55 - column 4, line 5 column 4, line 34 - column 4, line 68 -----	9,10
X	US 4 196 910 A (AIZU SHOICHI) 8 April 1980 (1980-04-08) figures 5-7 column 2, line 22 - column 2, line 37 column 4, line 18 - column 5, line 13 -----	1-3,5-7
X	US 5 890 881 A (ADEFF GEORGE A) 6 April 1999 (1999-04-06) abstract; figures column 1, line 7 - column 1, line 13 column 1, line 60 - column 2, line 12 column 2, line 66 - column 3, line 52 -----	1-3,5,7, 8
X	JP 58 093932 A (NISSAN JIDOSHA KK) 3 June 1983 (1983-06-03) abstract -----	1,2,4,5, 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 03/00042

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-10

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-10

A turbocharger comprising

a compressor impeller connected by a shaft being rotatably supported in a bearing with a turbine wheel; and
a sealing arrangement for avoiding leakage between a bearing and the space where one of the compressor impeller or the turbine wheel are located,
wherein said sealing arrangement comprises at least one pressure increasing means for increasing the pressure at a low pressure side of the sealing portion.

---

2. claims: 11,12

A turbocharger with a turbine side actuating mechanism for actuating a device within the turbocharger housing from outside the turbocharger housing, said mechanism comprising a rod which is rotatably mounted in the turbocharger housing for transmitting an actuating movement from outside the turbocharger housing to the device, wherein said rod is provided with a sealing portion for avoiding gas leakage.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/IB 03/00042

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0357246 A	07-03-1990	JP 2045616 A	15-02-1990
		JP 2623736 B2	25-06-1997
		DE 68924512 D1	16-11-1995
		DE 68924512 T2	04-04-1996
		EP 0357246 A2	07-03-1990
		US 5076765 A	31-12-1991
US 3825311 A	23-07-1974	NONE	
DE 3817617 A	20-07-1989	DE 3817617 A1	20-07-1989
EP 1273765 A	08-01-2003	CA 2352021 A1	03-01-2003
		US 6368077 B1	09-04-2002
		EP 1273765 A1	08-01-2003
US 4752193 A	21-06-1988	EP 0143182 A1	05-06-1985
		IN 161658 A1	09-01-1988
		JP 60156935 A	17-08-1985
		KR 8900570 B1	21-03-1989
		PL 249402 A1	21-05-1985
US 4196910 A	08-04-1980	JP 54152806 U	24-10-1979
US 5890881 A	06-04-1999	AU 5362298 A	22-06-1998
		BR 9714473 A	16-05-2000
		CN 1245553 A ,B	23-02-2000
		DE 69721036 D1	22-05-2003
		EP 0941431 A1	15-09-1999
		JP 2001506735 T	22-05-2001
		KR 2000057256 A	15-09-2000
		WO 9823886 A1	04-06-1998
JP 58093932 A	03-06-1983	NONE	

PUB-NO: WO2004063535A1
DOCUMENT-IDENTIFIER: WO 2004063535 A1
TITLE: SEALING MEANS FOR A LUBRICATION SYSTEM IN A TURBOCHARGER
PUBN-DATE: July 29, 2004

INVENTOR-INFORMATION:

NAME	COUNTRY
MATHIEU, PHILIPPE	FR
FIGURA, GIORGIO	FR
GENIN, EMERIC	FR
LAVEZ, ALEXIS	FR

ASSIGNEE-INFORMATION:

NAME	COUNTRY
HONEYWELL INT INC	US
MATHIEU PHILIPPE	FR
FIGURA GIORGIO	FR
GENIN EMERIC	FR
LAVEZ ALEXIS	FR

APPL-NO: IB00300042
APPL-DATE: January 10, 2003

PRIORITY-DATA: IB00300042W (January 10, 2003)

INT-CL (IPC): F01D025/18

EUR-CL (EPC): F01D011/00 , F01D025/18 , F04D029/12

ABSTRACT:

CHG DATE=20040802 STATUS=O>A turbocharger comprises a compressor impeller (1) connected by a shaft (5) being rotatably supported in a bearing with a turbine wheel (3) and at least one sealing arrangement with a sealing portion for avoiding leakage from the bearing to the space where one of the compressor impeller and the turbine wheel are located. The sealing arrangement comprises at least one passage (23) for increasing the pressure at a low pressure side of the sealing portion consisting of a seal ring. The turbocharger can be preferably used in a multi-turbocharger boosting system.